Tangram Treemaps

An enclosure geometrical partitioning method with various shapes

University of Technology, Sydney

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By

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CERTIFICATE OF AUTHORSHIP/ORIGINALITY

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I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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R^2: represents a two-dimensional plane in Euclidean geometry;

S: represents a subset of Euclidean space R^2 is compact if and only if it is closed and bounded.

N: indicates a node is the fundamental unit of which graphs are formed in graph theory. A subset of Nodes are presented by $\mathbf{n_1, n_2, \ldots, n_m}$, such as $\mathbf{N = \{ n_1, n_2, \ldots, n_i, \ldots, n_j, \ldots, n_m\}}$. **m** indicates the Number of Values; **i ,j** indicates the Number of Values.

P: a Polygon bounded by a closed path in a geometry shape. We map Node in tree structure into Polygon representation, e.g. for example, For the Node **N** is transferred as a Polygon **P (N**)

ℓ: Straight line segments which the polygon composed of. For example, a finite sequence of $\mathbf{L: = \{ \ell\ (v_1, v_2),\ ..\ \ell\ (v_{n-1}, v_n)\}}$. $\mathbf{\ell\ (v_{e-1}, v_e)}$**:** present The longest side.

V: In the polygon represents the points where two edges meet are the polygon's vertices. A set of vertices which a polygon composed of, are presented in a set of $\mathbf{V: = \{\nu_1, \nu_2, \ldots, \nu_I, \ldots, \nu_j, \ldots \nu_n\}}$,

$\boldsymbol{\nu_s}$ Initial vertex and $\boldsymbol{\nu_{s'}}$ which is the pointν_s transferred to the side after partitioning happened; $\boldsymbol{\nu_c}$ which is cutting vertex and $\nu_{c'}$ which is the point $\boldsymbol{\nu_s}$ transferred to the side after partitioning happened,

A: The Area size of polygon. The area size of a polygon equals the area size of a set of sub-polygons $\mathbf{A: = \{a_1, a_2, \ldots, a_i, \ldots a_j, \ldots, a_n\}}$.

W: A weight of a value associated with the property of a vertex. e.g., $\mathbf{W: = \{w_1, w_2, .., w_i, .. w_j, \ldots w_n\}}$. $\mathbf{W_{g1}}$ $\mathbf{W_{g2}}$ present subgroups of **W**, e.g.**,** $\mathbf{W: = \{W_{g1}, W_{g2}\}}$;

Θ: an interior angle formed by two sides of a polygon that share an endpoint. **θ:=** **{ θ_1 ,θ_2, …, θ_i,…,θ_j,…,θ_n }** ; **θ_{min}** defines Minimum Angular resolution Constraint; **α**: partition angle

ALGORITHMS LIST

ABSTRACT

In practices, analysts need to monitor multiple views and real time processes in one physical screen simultaneously regularly, due to the time demands or multi-task requirements. More often the visualization tool shares the screen space with other concurrent projects or process sessions. Although the traditional enclosure (or space-filling) tree approach can guarantee the maximization of space utilization in an isolated session display (that commonly occupies a single rectangular geometrical area), they however do not consider the maximization of display utilization of the whole computer screen, where a number of concurrent sessions are running in one screen.

This thesis proposes a new enclosure visualization method, named Tangram Treemaps that achieves the maximization of the computer screen utilization through the flexibility of display (or container) shapes. Breaking through the limitation of rectangular constraint, the new approach is able to partition various polygonal shapes. Furthermore, our algorithms also improve the efficiency of interactive tree visualization significantly, through the reduction of the computational cost.

Finally, we provide three case studies to demonstrate the commercial value of our method by using different datasets; we evaluate the method according to graph drawing and perceptual guidelines to show the advantage in scientific measurements; we conduct three user studies to compare the performance of our method with the traditional treemaps. Research results have proven that Tangram Treemaps could be adopted into a wider range of applications, taken in account its real-time performance and the quality of the visualization layouts.